MASSACHUSETTS FORESTRY CONSERVATION MANAGEMENT PRACTICES FOR WOOD TURTLES

Version 2007.1

Prepared by

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CMPs are meant to serve as guidelines for landowners and consulting foresters to aid in development of M.G.L. Chapter 132 Forest Cutting Plans that are compliant with provisions of the Massachusetts Endangered Species Act (MESA) (M.G.L. 131A) and its implementing regulations (321 CMR 10.00). In some cases, actual practices required for compliance with MESA may differ from published CMPs. Adherence to CMPs during forestry projects shall not necessarily constitute compliance with other state laws, or with local and federal laws.

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SUMMARY

The Wood Turtle (*Glyptemys insculpta*) is a medium-sized turtle, recognizable by its sculpted shell and orange coloration on the neck and forelimbs. Wood turtles require both aquatic and terrestrial habitats to complete their life cycle. Rivers and streams are used extensively throughout the year for foraging, mating and overwintering. During the late spring and summer, these turtles are often terrestrial. Wood Turtles are associated with forested areas, particularly mixed forests that have good shrub canopy cover and open areas. Females usually move farther away from streams and spend more time within terrestrial habitats than males. Most Wood Turtles stay within 1000 feet of their home stream.

The primary concern about forestry practices within Wood Turtle habitat is direct mortality of adults due to crushing by equipment. Alteration of aquatic, riparian, and nesting habitats is also a concern. To avoid direct mortality, it is required that access to the harvesting site with motorized vehicles be restricted to when Wood Turtles are inactive during the winter or to when turtles are not occupying the terrestrial habitat. Therefore, seasonal distance restrictions will apply to areas on either side of perennial streams within Wood Turtle Priority Habitat, up to 600 feet from the edge of the stream bank. In order to protect stream habitats and water quality, all perennial streams must be bridged and 25-foot no-cut strips bordering perennial streams are recommended. Stream crossings should be marked and identified before snowfall so that potential nesting habitat is avoided. Landings should be located at least 50 feet away from main roads in order to help prevent road kill of females that may use the open landing area as nesting habitat.

The Role of Forestry in the Conservation of Wood Turtles

Maintaining forested land in forest use is vital to conserving viable populations of Wood Turtles. In addition, timber harvesting is often essential for private forestlands to remain economically viable, and if public and private forestlands are to supply renewable wood products to sustain local economies. However, forest managers need to recognize that harvesting can potentially result in direct mortality to individual turtles, and should look to conserve Wood Turtles and other rare species proactively, in order to maintain the integrity of forest ecosystems.

CONDENSED VERSION OF THE FORESTRY CONSERVATION MANAGEMENT PRACTICES FOR WOOD TURTLES

For the full version of the forestry conservation management practices including the management objectives and the rationale supporting them, see page 16.

Species Identification and Biology - The Wood Turtle is a medium-sized turtle that can be recognized by its sculpted shell and orange coloration on the neck and front legs. It spends the winter in perennial streams and rivers. During the active season from March until November, it uses terrestrial habitats bordering streams. Females are more terrestrial than males and move farther away from streams. Wood Turtles do not reproduce until they are older than a decade and adults can live at least 50 years.

Forestry Practices - These management practices are based on the recognition that turtle conservation in general requires minimizing all sources of adult mortality. Wood Turtles specifically require maintenance of river or stream habitat in association with forested areas.

R – required management practice **G –** guideline or recommended management practice

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R Motorized vehicle use, consistent with the Massachusetts Forestry Best Management Practices, within the 600-foot forested corridor on either side of perennial streams, brooks or rivers identified as Priority Habitat for Wood Turtles may proceed according to the following time and distance requirements:

Distance from stream edge (feet)	Time periods when access with motorized vehicles can occur
0 – 50	Nov. 15 – February 28
50 – 300	Nov. 1 – March 31
300 – 600	Oct. 15 – May 15
600+	No restriction unless specified conditions exist*

*Distance restrictions may be extended beyond 600 feet to a maximum of 1000 feet for habitat features such as wetlands and nesting and early-successional habitat.

R The boundary of the 50, 300, and 600-foot management areas from the perennial stream shall be clearly identified by flagging or marking prior to cutting plan approval and harvesting if harvesting occurs between April 1 and October 31.

R All perennial stream crossings shall be temporarily bridged. Bridges shall be laid down across streams prior to any motorized equipment crossing it.

R If the harvesting area must be accessed by motorized vehicles for activities, such as preparation of the site, stream bank stabilization or clean-up work, outside of the allowable time periods, then a service forester and the NHESP must be contacted. Before the site is accessed, a response from the NHESP shall be obtained in order to determine that no adverse effects to Wood Turtles will occur. If NHESP does not respond within 10 business days, then the service forester shall presume that no special action is required.

R If trees will be harvested in vernal pool and stream filter strips then the boundary of filter strips along streams and surrounding vernal pools and other water bodies shall be clearly identified by flagging or marking prior to cutting plan approval. The trees that will be harvested within these filter strips shall also be marked prior to cutting plan approval.

G A 25-foot no-cut area within the filter strips along perennial streams and rivers is recommended in order to minimize streambed disturbance and erosion, maintain microclimate conditions of the stream, and to provide a source of future large woody debris.

G Increasing the width of filter strips in Wood Turtle Priority Habitat is beneficial, as this will increase the area where disturbance to the forest floor and to the coarse woody debris is minimized. Increased filter-strip width is particularly desirable near stream crossings and in high-gradient streams, where water may run off wood and skid roads.

G Identify and mark all stream crossings prior to snowfall. Avoid crossing stream channels in areas that have a sandy or gravelly substrate, less than 20% vegetation, exposure to sunlight, and are elevated at least 3 feet above the water level.

G Locate new landings at least 50 feet away and as far away as possible from roads, when the landing is located between a perennial stream and a road (Figure 1). This may help reduce attracting nesting females to the area immediately next to the road where the chance of road kill is higher.

G Leave limbs and tops in the forest, consistent with other laws, regulations, and forestry best management practices, in order to provide cover areas with cooler microclimates.

G Avoid leaving brush piles in open areas close to the stream. These open areas might be used for nesting; thus they need to remain exposed to sunlight.

G Any seed used to stabilize stream banks at crossings should be a mix of species native to Massachusetts when used within 200 feet of rivers, streams, and brooks.

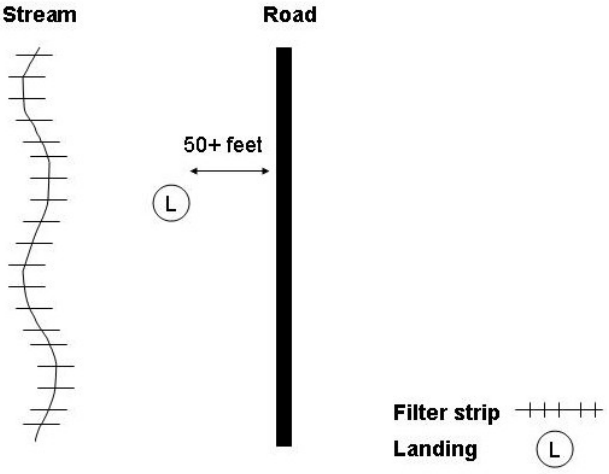

Figure 1. Recommended landing location to reduce attracting nesting female Wood Turtles close to roads.

SPECIES BIOLOGY

WOOD TURTLE: The orange-legged terrestrial turtle with the sculpted shell

Figure 2. Adult Wood Turtles can be recognized by their sculpted shell and orange coloration on their necks and limbs.

They lie in the warmth of sunny spring days, the males chase females or spar with each other, the females travel far and wide to find a good place for their offspring, they congregate at the best local spot for food or make long trips for particular delicacies, take refuge from the summer heat in cool forests, elude their predators by standing still, and return to their favorite spots for the winter. These are all activities of the Wood Turtle, a medium-sized, secretive woodland turtle that is found in the vicinity of rivers and streams. In the late spring, you might encounter a female digging a nest on an exposed gravel bar, a sandy bank, on the edge of an open field, or at the local gravel pit. To find one at the height of the mid-summer heat, you could search through the leaf litter on the forest floor. In the late summer, you might look around the best berry patch or mushroom bloom. And in the winter, you would have to enter the icy waters of a clear-water stream.

Species Identification

Figure 3. The male (left) has a concave plastron and the female (right) has a flat plastron. The male is old; all the growth rings have been smoothed away. The female is younger with about 12 growth rings on the scutes.

The Wood Turtle is a medium-sized turtle that can be recognized by its sculpted shell and orange coloration on the legs (Figures 2 and 3). The carapace (upper shell) is rough and each scale (scute) rises upwards in an irregular pyramid of grooves and ridges. The carapace also has a central ridge. The outer scutes at the back of the carapace are strongly flared in juveniles and females and are jagged in all individuals. The carapace is tan, grayish-brown or brown with a pattern of black or yellow lines on the larger scutes. The plastron (lower shell) is yellow with oblong dark patches on each scute. The head is black, but may be speckled with faint yellow dots. The legs and neck can have orange to reddish coloration. Hatchlings lack the orange coloration. They have a dull-colored shell that is broad and low and a tail that is almost as long as their carapace. Wood Turtle coloration provides camouflage allowing them to avoid predators by remaining very still and blending in with the background. Males are slightly larger than females. The best distinguishing characteristic of males is their concave plastron; they also have long, thick tails, long front claws, and a wider and more robust head than females (Fig. 3).

Wood Turtle Biology
Quick Reference Chart

Adult size (carapace length): 5½ - 8 in (16-20 cm)

Size at sexual maturity: Males 7 ½ - 7 3/4 in (19.2 - 20.0 cm)
Females 6 ½ - 7 1/4 in (15.8 - 18.5 cm)

Number of years to reach sexual maturity: 14 -18

Clutch size: 7 on average in MA

Hatchling size: 1 1/8 - 1 ¼ in (28 - 37.9 mm)

Annual adult survival rate: 95%

Life span: at least 45 - 55 years

Figure 4. Carapace of an adult female.

Coloration of shell and skin: shell brownish with black or yellow rays; skin dark brown except for yellow, orange or red markings on throat, neck, tail and underside of forelimbs

Shell characteristics: ridged and sculpted shell, upper shell not particularly domed, central ridge on upper shell, lower shell not hinged

Life Span and Time to Maturity

The approximate age of Wood Turtles can be determined by counting the number of growth rings on the scutes of the plastron (Fig. 4). These rings are laid down annually. Using this method to determine age is only reliable until the turtle has 20 growth rings. After 20 years estimating the age becomes very speculative because of slowed growth and scute wear. Most Wood Turtles begin to reproduce when they are over a decade old and usually between the ages of 14 and 18 years. In turtles, size can be a better indicator of reproductive status than age. Growth will occur more slowly in populations at the northern limit of the turtles' range because of colder weather conditions and shorter growing seasons. Sexual maturity for the male Wood Turtle occurs at carapace lengths between 7 1/2 - 7 3/4 inches for males and at 6 ½ - 7 1/4 inches for females. Wood Turtles living in the wild have been known to survive to at least 46 years and in captivity to 58 years of age.

Similar Species in Massachusetts

Snapping Turtles and Diamondback Terrapins might be confused with Wood Turtles because of similarity between their shells. However, their habitats are quite different. Snapping Turtles are a freshwater turtle often associated with ponds and lakes and Diamondback Terrapins live in salt-marsh habitat. The Wood Turtle is more terrestrial and is more likely to be associated with rivers or streams. Other land turtles that can occur in the same habitat as the Wood Turtle are the Eastern Box Turtle and the Blanding's Turtle. Both of these turtles' shells are more dome-shaped and their plastrons are hinged. The Wood Turtle's plastron is solid.

Wood Turtle Range

The Wood Turtle has the most northerly range compared to the overall ranges of other turtle species in Massachusetts. It is found from Nova Scotia westward to eastern Minnesota, through the upper half of Michigan and most of Wisconsin. In the eastern portion of its range it occurs only as far south as the mountains of northern Virginia. The known occurrences of Wood Turtles in Massachusetts are shown in Fig. 5. Although the number of sightings of Wood Turtles has increased in the state since it was first listed, it should be kept in mind that little is known about the status of local populations associated with the majority of these sightings.

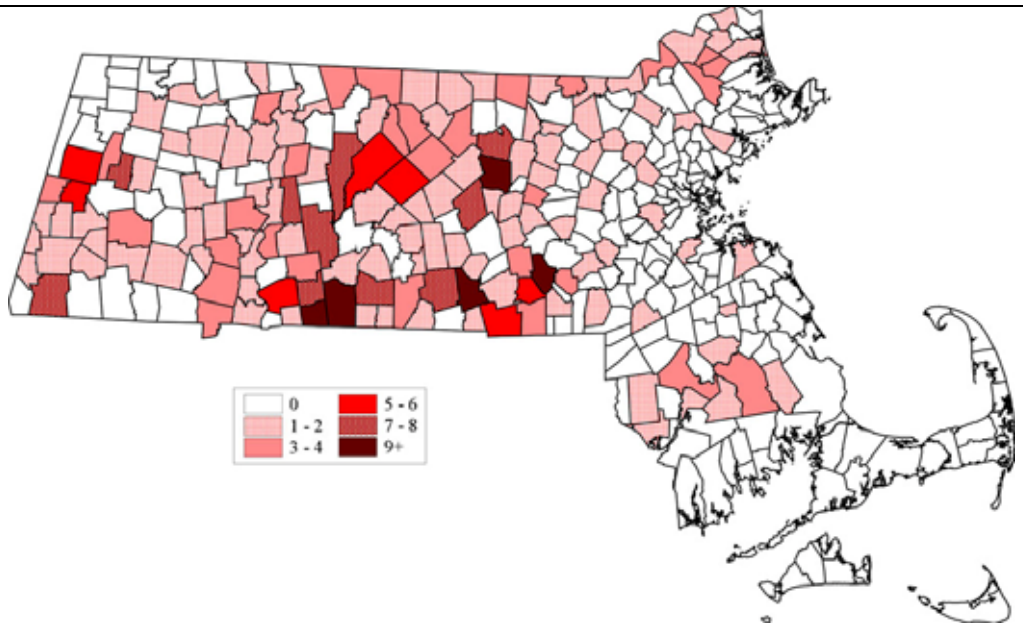

Figure 5. Documented occurrences of Wood Turtles per town in Massachusetts over the past 25 years. Although the Wood Turtle appears widespread, the majority of the towns in Massachusetts have fewer than 5 known occurrences. Each occurrence in the Natural Heritage database represents a population.

Wood Turtle Movements and Home Range

Most Wood Turtles stay within a 1000-foot wide corridor on either side of their home stream, but individuals have been known to move to 2000 feet and even beyond (Table 1 and Figure 6). A Wood Turtle could move this distance in a day or two. The maximum recorded distance for a female and male Wood Turtle over the course of two days occurred in New Hampshire (Tuttle and Carroll, 2003). The female traveled 1430 feet and the male 3200 feet. This is impressive for an animal that only reaches a maximum size of 9 inches in length.

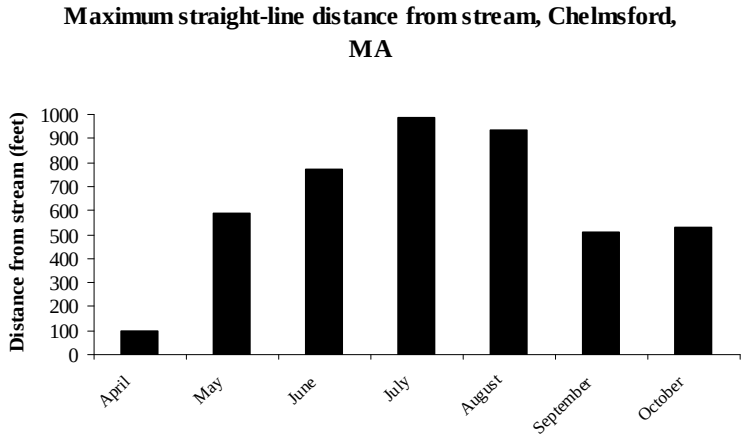

Figure 6. Maximum straight-line distances observed for single turtles from overwintering stream. Observations were from a study of 9 adult Wood Turtles from April to October, 2004. Maximum monthly distance observations were from five of the study animals. Thus, long distance travel cannot be attributed to the behavior of a single turtle (Luna, Luna and Jones, pers. comm..).

	Straight-line distance moved from stream (feet)									
	Average			90%	95%	Max	#	#	#	
State	Males	Females	All				Turtles	Observations	Seasons	Source
Massachusetts	-	-	-	-	-	656	5	26	<1	Robakiewicz, 1993
West Virginia	-	-	-	-	-	656	4	-	<1	Niederberger and Seidel, 1999
Massachusetts	156	290	249	522	557	757	28	486	2	Dan Wells and Bryan Windmiller, unpubl. data
New Hampshire	-	-	154	-	574	758	10	489	1	Tuttle and Carroll, 2003
Quebec	-	-	-	492	-	984	20	825	2	Arvisais et al., 2002
Massachusetts*	-	-	276	536	599	984	9	60	1	Ruth Luna, unpubl. data
Vermont	-	-	604		-	1394	7	-	4	S. Parren, unpubl. data
Maine	-	-	-	583	797	1965	37	2099	2	Compton, 1999
Pennsylvania	-	-	-	-	984	1968	50	-	6	Kaufmann, 1992
Massachusetts*	403	800	623	-	-	3041	53	-	1	Mike Jones, unpubl. data

* Average of maximum distances traveled

Table 1. Straight-line distances moved by Wood Turtles away from streams.

Although male Wood Turtles can cover greater distances within a shorter time period then females, they typically stay closer to their home stream. Even though the majority of Wood Turtles stay within a 1000-foot corridor along streams, individuals have been known to move farther. They have moved up to 1900 feet in Maine and Pennsylvania and up to 3000 feet in Massachusetts (Table 1). Wood Turtles also move within stream channels. Unlike the distances moved on land, males within streams seem to move farther. Data collected in 2004 on 53 Wood Turtles found that female movements within streams averaged 1800 feet and male movements averaged 5000 feet (Jones 2004, pers. comm.).

Individual Wood Turtles can use an area of land up to several hundred acres in size (Table 2). The amount of land needed to maintain a local population is even greater. Many of the documented sightings in the NHESP database for Wood Turtles are of just one or two individuals. However, these individuals are part of a local population that will use a larger area than what is required by a single turtle.

	Average (Acres)			Maximum (Acres)			#	#	
State	Males	Females	Adults	Males	Females	Adults	Turtles	Seasons	Source
Wisconsin	1	2	-	-	-	-	9	<1	Ross et al., 1991
Pennsylvania*	12	8	-	16	10	-	10	3-5	Kaufmann, 1995
New Hampshire	59	18	-	168	49	-	10	1	Tuttle and Carrol, 2003
Ontario	-	-	59	-	-	284	8	3	Quinn and Tate, 1991
Quebec	-	-	70	-	-	324	20	2	Arvisais, Bourgeois et al., 2002

*extended trips excluded

Table 2. Summary of annual Wood Turtle home range sizes.

Life History of the Wood Turtle

Wood Turtles are found in and around riverine habitat within forested watersheds and agricultural areas. They require both aquatic and terrestrial habitats in order to complete their life cycles (Fig. 7). Wood Turtles are active from early spring until late fall. During the late fall, winter and early spring they are closely associated with rivers and streams. This aquatic habitat is important for mating, basking, foraging and overwintering. Terrestrial habitat becomes important in the late spring and summer for females looking for nest sites, for juveniles and adults foraging on land, and for hatchlings emerging from their nests.

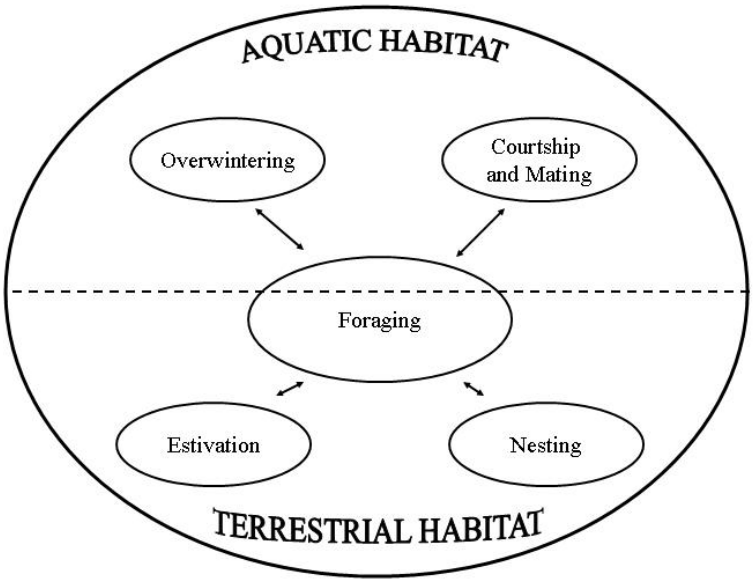

Figure 7. Diagram of habitats and life history stages of Wood Turtles.

Life History Quick Reference Chart

WHAT	WHERE	WHEN
Overwintering	Aquatic habitat: Flowing rivers and perennial streams or brooks, sometimes beaver lodges and muskrat burrows	Late fall to early spring: November to mid-March
Spring activity	Aquatic and riparian habitat: perennial brooks and streams	Early spring: mid-March to early April
Terrestrial habitat use	Terrestrial habitat: deciduous forest, coniferous forest, mixed forests, cornfields, hay fields	March to November – peak from June to October
Courtship and mating	Aquatic habitat: rivers and perennial streams and brooks	April to October – mostly in spring and fall
Nesting and hatchling emergence	Terrestrial habitat: open areas with sand or gravel substrate, sandy river banks, riverine gravel bars, road and railroad embankments, gravel pits	Nesting – June Hatchling emergence – August to October
Foraging	Aquatic and terrestrial habitat: vernal pools, marshes, ponds, bogs, streams, beaver ponds, forests, fields and meadows	April to November

Overwintering

Wood Turtles typically spend the winter in flowing rivers and perennial streams, returning to their home streams in the late fall. Full-time submersion in the water for the duration of winter begins in November, once freezing occurs regularly overnight, and continues until temperatures begin to increase in March. Within the river, Wood Turtles may find a spot in the bank under the water, between overhanging tree roots or beside a submerged log or rock. Wood Turtles also use beaver ponds and beaver or muskrat burrows. Often they will just rest on the bottom of the stream and are visible throughout the winter. Individuals may congregate at good overwintering sites and some will return to the same overwintering spot on a yearly basis. The activity and metabolism of the turtles becomes greatly reduced with cold temperatures and the turtles stop eating during the winter months.

Streams used by Wood Turtles have clear, flowing water, intermittent deeper pools, and usually a sandy or gravelly substrate. Wood Turtles are typically found in streams that have good water quality. In Massachusetts, they are found in habitats ranging from high-gradient streams surrounded by forest to low-gradient streams in agricultural valleys. Wood Turtles have been found in streams that have a variable depth, ranging from a couple of inches to deeper pools that may be 5 or more feet deep. The width of the stream may be a few yards up to 100 feet across. Streams with a clay, silt or muck bottom are less likely to be inhabited.

Spending the winter within flowing water has an advantage compared to overwintering in a pond or lake that has still water. The oxygen level in streams is typically higher and the flowing water helps prevent ice from forming. While a turtle underwater can absorb oxygen through thin skin on the mouth and cloaca, getting enough oxygen during the winter can be difficult.

Spring Activity

The Wood Turtle may make underwater movements in the stream during the winter; however, extended periods of activity and emergence from the water do not occur until the early spring, usually mid-March to early April. Early in the spring, the activity and movements of Wood Turtles are minimal and they spend most of their time basking. They are active during the day and their activity is confined initially to the banks of the stream where they spent the winter. Turtles will use emergent logs or grassy, sandy and muddy banks to soak up the spring sun.

Terrestrial Habitat Use

Wood Turtle populations are found in both forested and agricultural areas. They have been referred to as an “edge-species” because they are often found at the interface between two habitat types. Early successional habitat is particularly important and Wood Turtles will travel through dense forest in order to get to open fields. Within heavily forested areas, turtles may actually be more closely associated with open areas where the canopy cover is not as dense. The range-wide descriptions of the forest types surrounding streams where Wood Turtles are found include deciduous, coniferous, and mixed forests.

Adults will begin foraging in the riparian area of streams in the early spring. Females increase their terrestrial habitat use during the nesting season in June. Overall, females tend to be more terrestrial and are found farther away from streams than males (Kaufmann, 1992; Tuttle & Carroll 2003). Foraging occurs for both males and females throughout the spring and summer in terrestrial habitats away from streams. At night and during periods of hot weather when Wood Turtles are on land they retreat to “forms”. These small terrestrial shelters are found beneath leaf litter, in the grass, or under logs or brush. They are called forms because when the turtle leaves them they retain the shape of the turtle’s shell. In the late fall, hatchlings emerge from their nest sites and move overland towards the aquatic habitat.

Reproduction

Although the peaks in mating activity occur in the spring and fall, Wood Turtles are known to mate throughout their activity period. Courtship between a male and female might begin at the edges of a stream or brook, but copulation usually takes place within the water. Mating occurs multiple times over the course of the active season with different individuals. Females store sperm from autumn mating encounters over the winter until the nesting season in June.

Nesting sites may a limited resource for Wood Turtles. In Massachusetts, nesting occurs over a four-week period in June. Females are known to travel long distances in search of appropriate nesting habitat. Once they have arrived at a suitable nesting area, there may be multiple nesting attempts or false nests that occur over the course of several days, prior to a nest site actually being excavated. Nesting is often associated with rain and usually occurs during the day but will continue into the evening.

Figure 8. Riverine nesting habitat of the Wood Turtle.

Females will often congregate in a good nesting area. Female Wood Turtles lay one clutch a year. Clutch size in Massachusetts averages 7 eggs (Jones, 2004, pers. comm.). Some overwintering streams or brooks have gravel bars or sandy banks that provide good nesting sites. For hatching to be successful, nests need to be high enough above the water to avoid flooding. The site also needs well-draining soil and exposure to direct sunlight. If appropriate habitat is not readily available close to the stream, females will travel to meadows, railroad beds, woodland roads, gravel pits, and the edges of agricultural fields. Movements from the stream to an open area that is a good site for nesting are often through forested corridors.

Predators that destroy nests include raccoons, skunks, ravens, foxes and coyotes. Nest predation is often so severe that all nests are destroyed. Surviving hatchlings will emerge from nests after approximately 2 to 2.5 months. Hatchlings have a specialized feature called a caruncle or egg tooth located on the upper jaw that allows them to break through the egg shell. This feature is lost shortly after emergence. The incubation temperature of the nest is important for determining the sex of some turtle species, but in Wood Turtles sex determination is genetic. Hatchlings move across the land towards aquatic habitats and are at risk of being eaten by raccoons, skunks, feral cats, dogs, opossums and birds. Once in the water, snapping turtles, bullfrogs, snakes, mink, birds and large fish are potential predators.

Foraging

Wood Turtles are not picky eaters and are considered opportunistic omnivores. They will eat wherever food may be found. Their diet consists of both plant and animal matter that is consumed on land and in the water.

Food sources are often utilized seasonally. For instance, they will eat slugs that have surfaced because of rainfall. Wood Turtles may venture into hemlock forests where they would not usually be found in order to eat mushrooms in the late summer. In aquatic environments, they eat algae, tadpoles, and fish. On land, they

consume leaves, flowers, fruit, moss, grasses and fungi. They are known to eat strawberry, willow and alder leaves. They will consume raspberries, strawberries, blackberries and blueberries. Their carnivorous diet includes slugs, insects, earthworms, newborn mice, other turtle eggs, carrion, and possibly the eggs and young of ground-nesting birds.

Certain populations of Wood Turtles have an interesting behavior to lure their prey out of the ground. They will stomp their front feet on the ground, presumably imitating the vibrations of falling rain, and earthworms respond by coming to the surface, only to meet their demise as the Wood Turtle's snack (Kaufmann, 1986).

WOOD TURTLE CONSERVATION CONCERNS

Status Across Range

In Massachusetts, the Wood Turtle is listed as a Species of Special Concern. Although the Wood Turtle is not currently listed as an endangered species in the United States, it is recognized as a species of special concern at the federal level in Canada. At the state level in the United States, its status ranges from a species of Special Concern in Rhode Island, New York, Michigan and Connecticut, to Threatened in Minnesota, New Jersey, Virginia and Wisconsin, to a very Rare and Imperiled species in West Virginia, and Endangered in Iowa. It was originally added to the state rare species list because of a lack of documented occurrences and reported declines, particularly in eastern Massachusetts. Although the number of records in the state has increased since it was initially listed, it continues to remain a species of concern for the reasons outlined below.

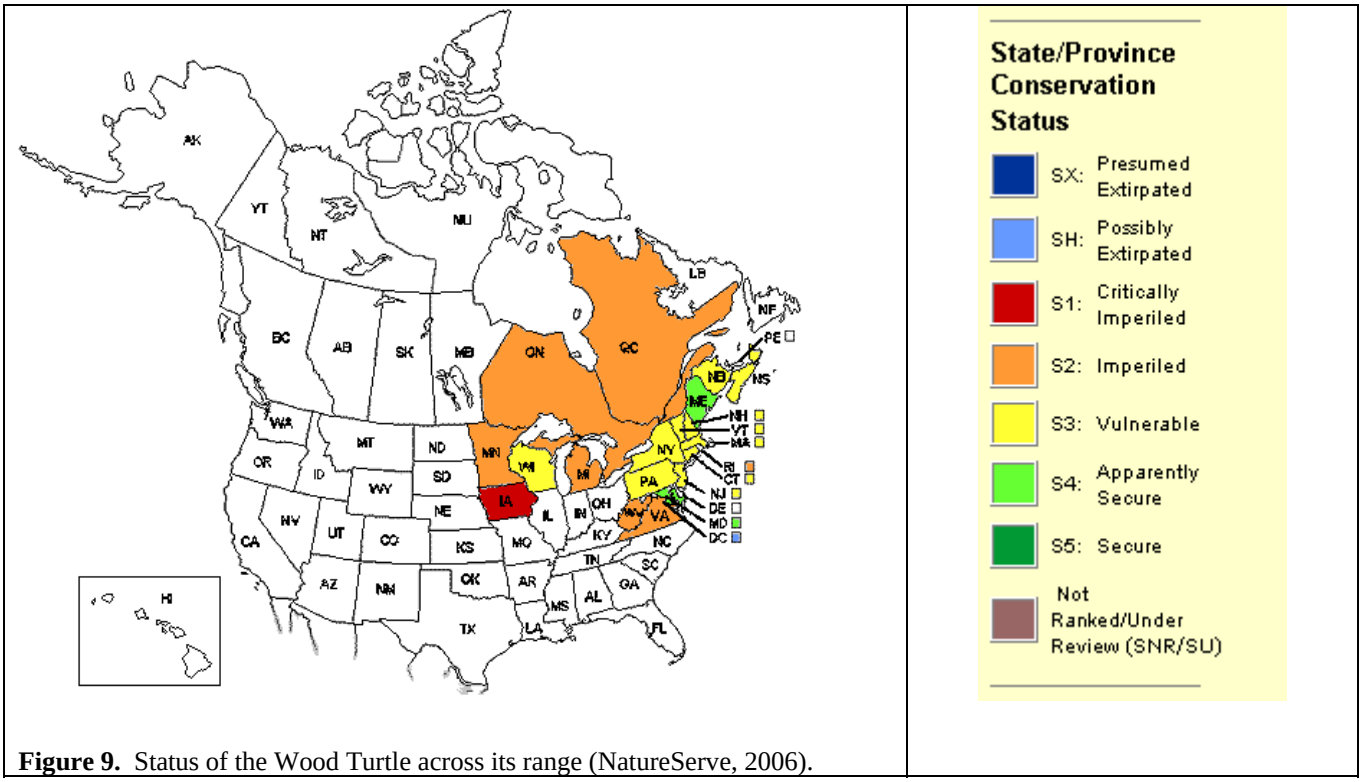

Figure 9. Status of the Wood Turtle across its range (NatureServe, 2006).

Turtle Population Biology

Turtle fossils date back over 200 million years to the Late Triassic period. Over time, turtles have evolved a reproductive strategy that makes them vulnerable to human disturbances. Hatchling survival from nests and juvenile survival is very low while the time to sexual maturity is long. These characteristics are

compensated by adults being long-lived and reproducing multiple times. Increases in population size tend to take a long time and the potential time to recover from a population decline is also long.

The classic story of the tortoise and the hare is a useful comparison to think of when considering the reproductive strategies of turtles as compared to many mammal species. In the same way that the movement of the individual animals differs, so does the amount of time needed to reach sexual maturity. Hares can start reproducing within a year of being born, while many turtle species take a decade to become a reproductive adult. Therefore, the potential to increase the size of a mammal population such as the hare occurs over a much shorter time frame than for turtles. Similarly, recovery from a population decline can occur much faster for a mammal than for a turtle.

The chances for a long life are much better for the turtle than for the hare. The slow and steady adult turtle lives a much longer life. A long life together with multiple years of reproduction compensates for low rates of hatchling and juvenile survival in turtles. However, this reproductive strategy that has evolved in turtles makes them exceptionally vulnerable to any disturbances that increase the rate of adult mortality. The survival of adult turtles on an annual basis is typically greater than 95%. Long-term studies of turtle populations as well as models of population dynamics indicate that increased mortality rates of adults that are as low as 2-3% annually may be enough to lead to the ultimate loss of a local population.

Activities that Impact Wood Turtle Populations

Habitat destruction, degradation or alteration, and fragmentation all threaten Wood Turtle populations. Increasing urbanization of areas in New Jersey, New York, Pennsylvania, Michigan and Massachusetts is responsible for declines and eradication of local populations in these States (Harding & Bloomer, 1979). Turtles are also particularly vulnerable to any activity that consistently reduces adult survivorship on a yearly basis. For example, populations in which adults cross roads in order to access habitats needed for completion of their life cycle are at a higher risk of extirpation because of road kills. Similarly, populations that border agricultural areas and suffer adult mortality on a yearly basis are also at a greater risk of being lost. The specific activities outlined below are concerns for many turtle species as well as for Wood Turtles specifically.

Commercial and casual collection

Collection for biological supply companies, the domestic and international pet trade, as well as for home pets has contributed to the decline and extirpation of Wood Turtle populations. The Wood Turtle and the closely related Bog Turtle, Spotted Turtle, and Western Pond Turtle have been popular species for the pet trade. It has been estimated that close to 5,000 turtles of these four species were exported from the United States between 1989 and mid-1994 (Burke at al., 2000). In recognition that without closely controlled trade, the Wood Turtle could become extinct, it was listed in Appendix II of the Convention on the International Trade of Endangered Species of Wild Flora and Fauna (CITES) in 1992.

Illegal collection and sale of Wood Turtles has been discovered in a number of States. Up until the late 1990's, Wood Turtles that were collected from the wild in other states were sold commercially in Ohio (Burke et al., 2000). This was due to a lack of protection in Ohio and misrepresentation as native fauna. In Vermont, illegally collected turtles, including Wood Turtles were confiscated by the Department of Fish and Game in 2003. A population of Wood Turtles in Ontario declined after poaching occurred in 1994. In Michigan, 14 people involved in illegal reptile trade including Wood Turtles were charged and fined. These are all instances of collecting for the commercial pet trade. However, extirpation of two Wood Turtle populations in Connecticut over the course of a decade from 1982-1992 was attributed to casual collection by individuals once the area had been opened up for recreational use (Garber & Burger, 1995).

Roadkill

Mortality of turtles because of road kill is a concern for all North American turtle species. Of particular concern is that many of the individuals moving across roads and being killed are female turtles looking for

nesting habitat. Highways with high traffic volumes become impenetrable barriers that isolate turtle populations and prevent dispersing individuals from maintaining genetic diversity across populations. Even smaller roads with moderate traffic volumes can cause enough mortality to cause a population to decline.

A modeling study that investigated the effects of road density and traffic volumes on turtles found that for land turtles such as the Wood Turtle, roads could contribute enough to annual adult mortality that positive population growth could not be maintained. Mortality rates greater than 5% were determined to cause decline in the size of local turtle populations based on previous long-term studies of various turtle species (Gibbs & Shriver, 2002). In Massachusetts, increased mortality rates because of road kill is certainly a concern and has been documented. Greater than 10% of the records in the Massachusetts Wood Turtle database are based on observations of dead turtles killed on roads and an even greater percentage report injuries because of attempts to cross roads.

Predation

In recent decades, raccoon and skunk populations have benefited from the availability of additional food sources such as garbage, bird seed and food for pets, provided by humans in commercial and residential areas. These mammals are efficient turtle nest predators. For turtle populations that border on areas developed for residential use, besides the direct loss of habitat, the increase in nest predators such as raccoons and skunks can be very detrimental to the hatching success of nests and greatly reduces the number of young turtles that are born and survive. Nest predation can destroy the majority of a turtle population's reproductive output on a yearly basis.

Mortality and injuries from heavy equipment

Wood Turtle populations are often found in areas with agricultural activities. Wood Turtles are known to use agricultural fields and utility rights-of-ways for nesting and foraging. However, mortality and injuries can result from Wood Turtles being run over by agricultural and other heavy equipment. A study of a Wood Turtle population in Quebec in an agricultural area found that there were fewer juveniles, increased shell injuries, and decreased growth, compared to a population in a forested area (Saumure & Bider, 1998). Similarly, Wood Turtle mortality has been observed in Massachusetts as a result of agricultural practices. Mortality from all-terrain vehicles (ATVs) and riding lawn mowers has also been documented.

Stream habitat alteration

Disturbances to stream and riparian habitats such as bank stabilization, channelization, damming and dredging are all potentially detrimental activities for the Wood Turtle (Buech et al., 1997). Activities that change the hydrology of the stream, the physical habitat itself, and water quality negatively affect Wood Turtles. Wood Turtles that occupy river stretches downstream from dams can experience mortality and nest destruction from dam releases (Norden, 1999). A study of Wood Turtles in Maine found that about 25% of the nests found were flooded because of dam releases (Compton, 1999). Although naturally occurring spring floods may be important for retaining unvegetated sites within the stream channel for nesting, water flows that do not mimic the natural hydrology of the area can be destructive. Any alterations to a stream or river that increase spring and fall flooding can have detrimental effects on both adults and hatchlings. Mortalities and injuries to Wood Turtles have been observed recently in Massachusetts following a spring flood (Jones, 2004, pers. comm.). Turtles were swept downstream and suffered injuries from colliding with rocks in the stream as well as being buried in sediment.

Forestry

Maintaining forested habitat in association with riverine habitat is essential for the conservation of Wood Turtles. The impacts of timber harvesting are recognized as having significantly fewer lasting effects as compared to other permanent changes in land use, such as residential and commercial development. However,

certain precautions should be taken during timber harvesting in order to maintain the long-term viability of Wood Turtle populations within forested areas.

Although Wood Turtles are found within forested areas, they prefer areas that do not have a fully closed canopy cover. Therefore, forestry practices that open up areas within a forest are beneficial for Wood Turtles as long as the area remains in a forested condition. The greatest concern during the actual forestry operations are turtles being run over and crushed by mechanized logging equipment. The habitat alterations that are of concern with forestry practices are any changes to the water quality and stream habitat that the Wood Turtle uses for overwintering, mating, and foraging. Another potential concern is creating nesting habitat along main roads. This nesting area might lure females into an area where there is a higher probability of being run over by a vehicle. Similarly, if a parcel across the road from a Wood Turtle home stream is being harvested and the habitat immediately surrounding the stream is more densely forested, the newly opened habitat may lure Wood Turtles across the road and increase mortality rates because of road kill.

FORESTRY CONSERVATION MANAGEMENT PRACTICES FOR WOOD TURTLES

The following management practices apply to forested areas surrounding perennial rivers, streams and brooks within Wood Turtle Priority Habitat. Reducing the frequency that motorized vehicles enter Wood Turtle habitat would be beneficial in minimizing direct mortality of adults. For long-term management, heavier cuts spaced at longer intervals would be favored over lighter cuts at more frequent intervals. These recommendations were made with the assumption that forestry equipment would only enter a site once per decade. If the time lag between motorized vehicles entering the site is shorter than 10 years, then a more conservative approach should be taken, with access to all areas within 600 feet of the perennial stream allowed only between November 15th and February 28th.

R – required management practice **G** – guideline or recommended management practice

Preventing Turtle Mortality

Conservation management objective

Avoid direct mortality of Wood Turtles from any timber harvest activity involving motorized vehicles.

Rationale

Individual survival of long-lived adults is important since they need to reproduce many times before they replace themselves in the population. Potential mortality of adults is avoided by not using motorized vehicles in areas or at times when Wood Turtles will be present.

General management recommendations

Adjust the timing and location of motorized vehicle use for timber harvest activities to when Wood Turtles are inactive or less likely to be occupying terrestrial habitat and temporarily bridge perennial stream crossings.

Specific management practices

R Motorized vehicle use, consistent with the Massachusetts Forestry Best Management Practices, may occur between 0 and 50 feet from the edge of both sides of a perennial stream from November 15th to February 28th. All motorized vehicles shall be excluded from this area from March 1st to November 14th.

Motorized vehicle use, consistent with the Massachusetts Forestry Best Management Practices, may occur between 50 and 300 feet from the edge of both sides of a perennial stream from November 1st to March 31st. All motorized vehicles shall be excluded from this area from April 1st to October 31st.

Motorized vehicle use, consistent with the Massachusetts Forestry Best Management Practices, may occur between 300 and 600 feet from the edge of both sides of a perennial stream from October 15th to May 15th. All motorized vehicles shall be excluded from this area from May 16th to October 16th.

Distance from stream edge (feet)	Months when access with motorized vehicles can occur
0 – 50	Nov. 15 – February 28
50 - 300	Nov. 1 – March 31
300 - 600	Oct. 15 – May 15
600+	No restriction unless specified conditions exist*

Table 3. Recommendations for motorized vehicle use for timber harvest activities according to straight-line distance from stream.

* These distances are the standard distances. However, in sites where certain habitat features may draw Wood Turtles beyond 600 feet, then the distance restrictions may be extended to a maximum of 1000 feet. Such habitat features may include wetlands, nesting habitat, and early-successional habitats. The habitat configuration that would be of particular concern is where continuously forested habitat (i.e. predominantly closed-canopy) exists along the perennial stream, with early successional habitat such as fields, occurring only beyond the 600-foot corridor.

R All perennial stream crossings shall be temporarily bridged in order to reduce disturbance of the stream bed and bank and to avoid mortality of Wood Turtles that are overwintering in the stream. Bridges shall be laid down across streams prior to any motorized equipment crossing the stream.

R If the harvesting area must be accessed by motorized vehicles for activities, such as preparation of the site, stream bank stabilization or clean-up work, outside of the allowable time periods, then a service forester and the NHESP must be contacted. Before the site is accessed, a response from the NHESP shall be obtained in order to determine that no adverse effects to Wood Turtles will occur. If NHESP does not respond within 10 business days, then the service forester shall presume that no special actions are required.

R The boundary of the 50, 300, and 600-foot management areas from the perennial stream shall be clearly identified by flagging or marking prior to cutting plan approval and harvesting if harvesting occurs between April 1 and October 31.

Protecting Important Aquatic, Riparian, and Microhabitats of the Wood Turtle

Conservation management objective

Maintain stream bank habitat structure, water quality of streams, flow rates and microhabitats in the riparian corridor.

Rationale

Maintaining the immediate bank habitat surrounding streams, as well as the stream water quality, is important, as the life cycle of Wood Turtles is centered on this aquatic habitat. The habitat within the stream channel includes important features such as rocks, logs and mammal burrows that are used for basking and overwintering. Forested filter strips help reduce any increase in water flow or erosion that can have negative effects on the habitat quality within the stream channel. These strips also maintain forest floor conditions and large woody debris along stream banks.

General management recommendations

Leave forested filter strips along both sides of streams, rivers, and brooks.

Specific management practices

R If trees will be harvested in vernal pool and stream filter strips then the boundary of filter strips along streams and surrounding vernal pools and other water bodies shall be clearly identified by flagging or marking prior to cutting plan approval and harvesting. The trees that will be harvested within these filter strips shall also be marked prior to cutting plan approval and harvesting.

G A 25-foot no-cut area within the filter strips along perennial streams and rivers is recommended in order to minimize streambed disturbance and erosion, maintain microclimate conditions of the stream, and to provide a source of future large woody debris.

G Increasing the width of filter strips in Wood Turtle Priority Habitat is beneficial, as this will increase the area where disturbance to the forest floor and to the coarse woody debris is minimized. Increased filter-strip width is particularly desirable near stream crossings and in high-gradient streams, where water may run off wood and skid roads.

G Leave limbs and tops in the forest, consistent with other laws, regulations, and forestry best management practices, in order to provide cover areas with cooler microclimates.

G Any seed used to stabilize stream banks at crossings should be a mix of species native to Massachusetts when used within 200 feet of rivers, streams, and brooks.

Maintenance of Nesting Habitat

Conservation management objective

Maintain potential nesting habitat areas, such as gravelly or sandy substrates with sparse vegetation.

Rationale

Nesting habitat is a landscape feature that may not be as common or as readily available to Wood Turtles as other resources that are needed to complete their life cycle. By avoiding any alteration of existing nesting habitat, any adverse effects to the reproduction of the local population will be minimized.

General management recommendations

Avoid altering existing habitat that could be used for nesting. The following characteristics would indicate potential nesting habitat:

Sandy or gravelly substrate
Less than 20% vegetation
Exposure to sunlight
Elevated at least 3 feet above the water level

Specific management practices

- Identify and mark all stream crossings prior to snowfall. Avoid crossing stream channels in areas that may provide nesting habitat in the riparian zone.
- Avoid leaving brush piles in open areas with the above characteristics. These open areas might be used for nesting; thus they need to remain exposed to sunlight.
- Locate new landings at least 50 feet away and as far away as possible from roads, when the landing is located between a perennial stream and a road (Fig. 10). This may help reduce attracting nesting females to the area immediately next to the road where the chance of road kill is higher.

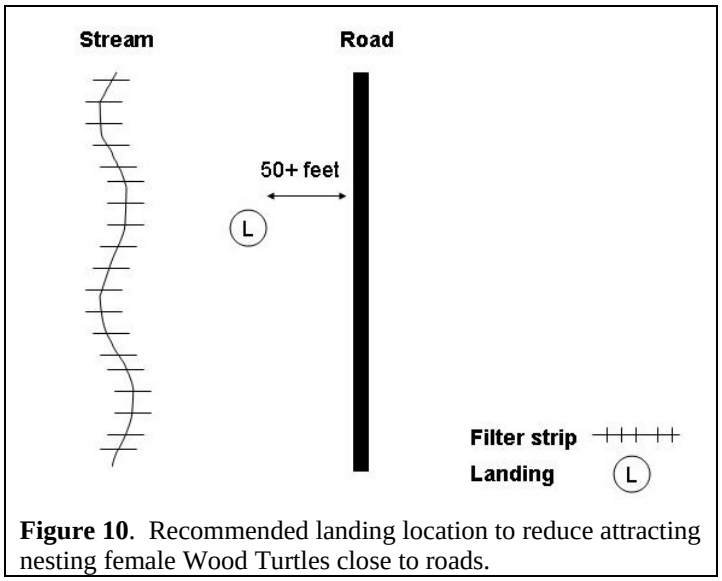

Figure 10. Recommended landing location to reduce attracting nesting female Wood Turtles close to roads.

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